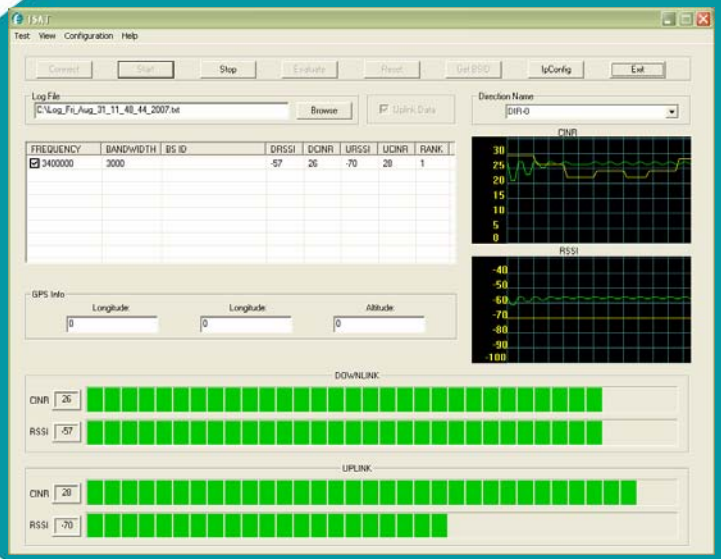
StarMAX™ Antenna Alignment Tool User Manual

Rel. 2.2, Version 1.1



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Abbreviations & Definitions

Abbreviation	Interpretation
TSAT	Telsima StarMAX™ Alignment Tool
BDF	Best Direction Finder
BLF	Best Location Finder
BS	Base Station
CINR	Carrier to Interference and Noise Ratio
RSSI	Receive Signal Strength Indicator
SS	Subscriber Station

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1 Preface

This book serves as a User Manual for the Telsima StarMAX™ Alignment Tool, providing basic software overview and details on antenna alignment.

Audience
This book will be useful for the support staff of the service provider.

Related Information
For more information, refer to the following:
StarMAX™ 2100 Series User Manual
.

Contact Us
If you purchased a service program from Telsima, you can get help at any time by calling Telsima:
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Europe: +386-1-588-7010
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You can also send us your comments by mail to:

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2 Overview of the Telsima StarMAX™ Alignment Tool

One of the most important steps during the Subscriber Station installation is the proper orientation and placement of the antenna. This procedure is useful also for the indoor StarMAX™ 2130 Subscriber Station, which has an internal 4-sector active antenna that automatically covers the full horizontal plane. The semi-outdoor StarMAX™ 2140 SS uses an external antenna connector for a choice of indoor or outdoor directional or omnidirectional antennas and is intended for indoor use with the antenna being mounted outdoors (or indoors) with a short (<3m) coaxial cable. The StarMAX™ 2150/2160 Subscriber Station is basically embedded into the antenna and is intended for full outdoor use/installation.

The Telsima StarMAX™ Alignment Tool (TSAT) offers two modes of operation; Best Location Finder and Best Direction Finder.

As a tool for pre-installation activities, the best location finder (**BLF**) helps the operator/customer to locate the best possible micro-location in the apartment/room/rooftop; the best direction finder (**BDF**) can then be used for best direction alignment to enable optimal data transfer in the WiMAX network.

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3 Installing the TSAT

The Telsima StarMAX™ Alignment Tool is a stand-alone software product, which can be downloaded through the Telsima Customer Support web page, available at http://www.telsima.com/cs.

How to install the Telsima StarMAX™ Alignment Tool:

1. In your Microsoft Windows® open the web browser and visit the Telsima Customer Support homepage at http://www.telsima.com/cs.
2. Download the **Telsima StarMAX™ Alignment Tool**.
3. Extract the ZIP archive into a folder and run the **Setup.exe** program file.
4. Install the application by clicking the **Next** and then the **Install** button.
5. When the installation is complete, close the installation window.

Note: You need Administrator system privileges to successfully install the Telsima StarMAX™ Alignment Tool.

6. Connect the ethernet RJ-45 (Ethernet) cable from your PC to the StarMAX™ Subscriber Station.
7. Turn on your StarMAX(TM) Subscriber Station.
8. Configure the PC TCP/IP connection properties as follows (please check chapter : Configuring Your Computer (MS Windows) for details:

   - IP address: **192.168.1.254 (anything in the range of 192.168.1.2-192.168.1.254)**
   - Subnet mask: **255.255.255.0**

9. Verify whether the StarMAX™ Subscriber Station is online: open Command Prompt (**Start**->**Run**->`CMD` [Enter] .
10. Ping the Subscriber Station with the command: `ping 192.168.1.1`.
11. If the command returns data on pinging intervals from the PC to the Subscriber Station, continue with the next step of this procedure; otherwise consult your Microsoft Windows® XP Help for additional information to resolve IP configuration issues, and the StarMAX™ 2100 Series Subscriber Station User Manual on how to correctly setup the StarMAX™ Subscriber Station.

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4 Running the Telsima StarMAX™ Alignment Tool

Run the Telsima StarMAX™ Alignment Tool by clicking the **Start**->**All Programs**->**TSAT**->**TSAT (Telsima)** icon.

The main program window will appear, as seen in the following picture:

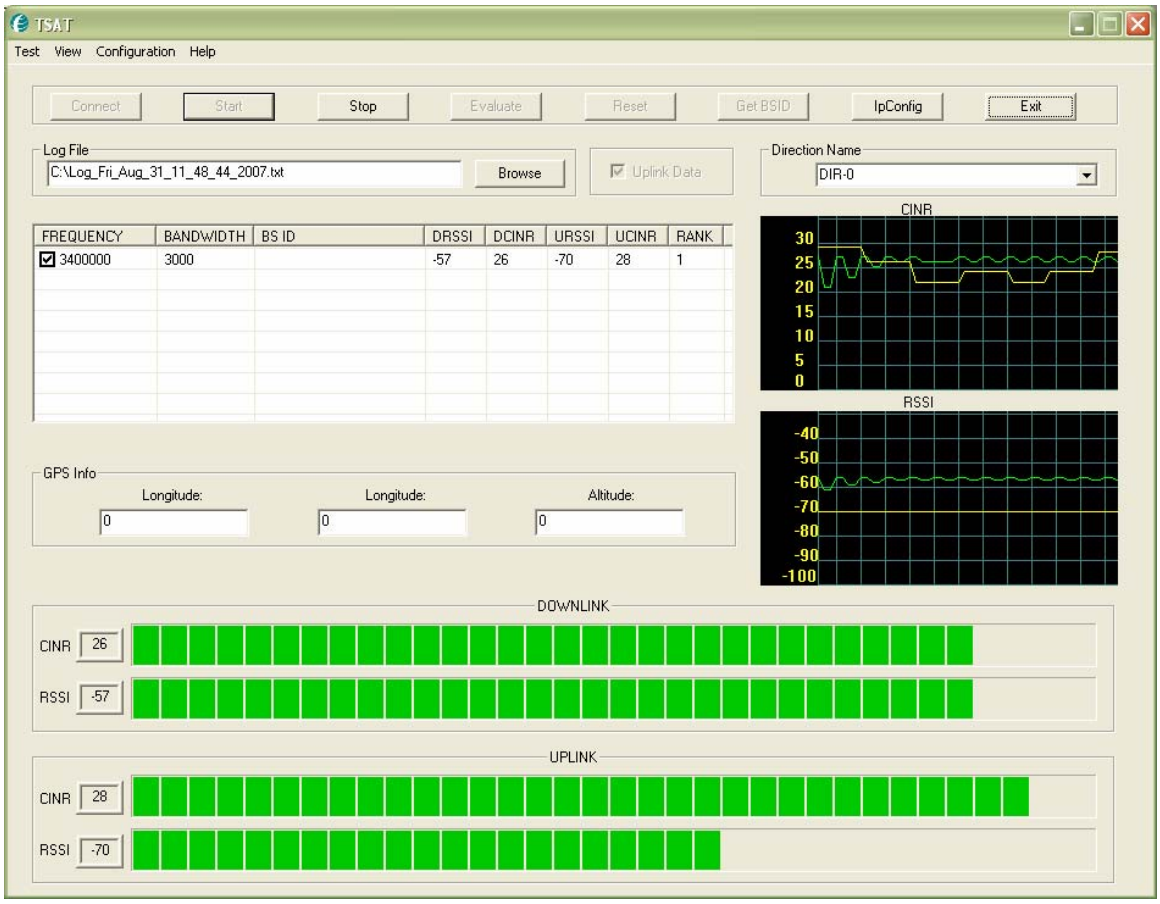

Figure 1: The Telsima StarMAX Alignment Tool program window

In this window you see 5 basic elements:

The **menu bar** contains basic operating options:

- The Test menu contains command for connecting to the Subscriber Station, starting, stopping, evaluating and resetting the testing function and the Exit option to close the TSAT program.
- The View menu contains two main options: **BDF** (Best Direction Finder) and **BLF** (Best Location Finder).
- The Configuration menu contains the option to set the Subscriber Station IP address and the Channel Configuration option.

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- The Help menu entry provides program version.

The **main command button bar** on the top contains the main operation buttons, similar to the options in the Test menu, used for fast basic Alignment Tool operation:

Connect: used to connect to the Subscriber Station for alignment purposes.
Start: used to start the automatic measurement procedure.
Stop: used to stop the automatic measurement procedure.
Evaluate: used to evaluate the measurement in the BLF/BDF modes respectively.
Reset: resets the alignment tool measured data.
Get BSID: used to get the BSID.
IpConfig: used to set the IP of the Subscriber Station you wish to align.
Exit: closes the Telsima StarMAX™ Alignment Tool.

The **Log File** entry field contains the path to the txt logfile, which contains all the data collected by the Alignment Tool. Next to it the checkbox for measuring the **UpLink connection** quality is also available.

The **central part of the program window** contains downlink and uplink measured RSSI, CINR, BS ID and ranking column, and at the side beside the frame bar graphs of the CINR and RSSI measurement history is visible. On the bottom of the window bar graphs of current RSSI & CINR for DL/UL are visible.

The **Direction/Location Name** entry field is used to name the specific Direction/ Location for further alignment reference.

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5 Evaluating the location

The standard StarMAX™ Subscriber Station best location finding procedure should be performed using a StarMAX™ 2130 or 2140 SS (indoor omnidirectional antenna) – even if you plan to use a StarMAX™ 2150r1/r2 outdoor unit afterwards.

The procedure is as follows:

1. Power the SS on.
2. Run the TSAT software.
3. Go to **View** and choose **BLF** (best location finder).
4. Set the IP address of the subscriber station (push the **IpConfig** button).

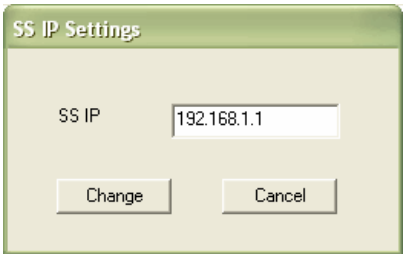
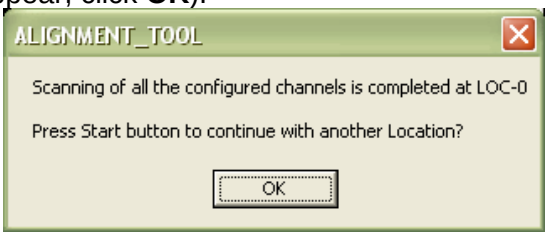


Figure 2: Setting the IP of the SS

5. Press the **Connect** button in TSAT.
6. Press the **Start** button and wait until scanning is completed (a new window will appear, click **OK**).


ALIGNMENT_TOOL
Scanning of all the configured channels is completed at LOC-0
Press Start button to continue with another Location?
OK

NOTE: You can use the geographical altitude, longitude and latitude values, collected from a GPS device, to have them stored with the measurements in the logfiles. This can help you in recording SS locational data for later overview.

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7. For each new location measurement click into the Location name field and type the new name for location (or increase the number in the name), and press the **Start** button to start measuring again. All measurements are saved in a table – you can view them by clicking the **Evaluate** button.

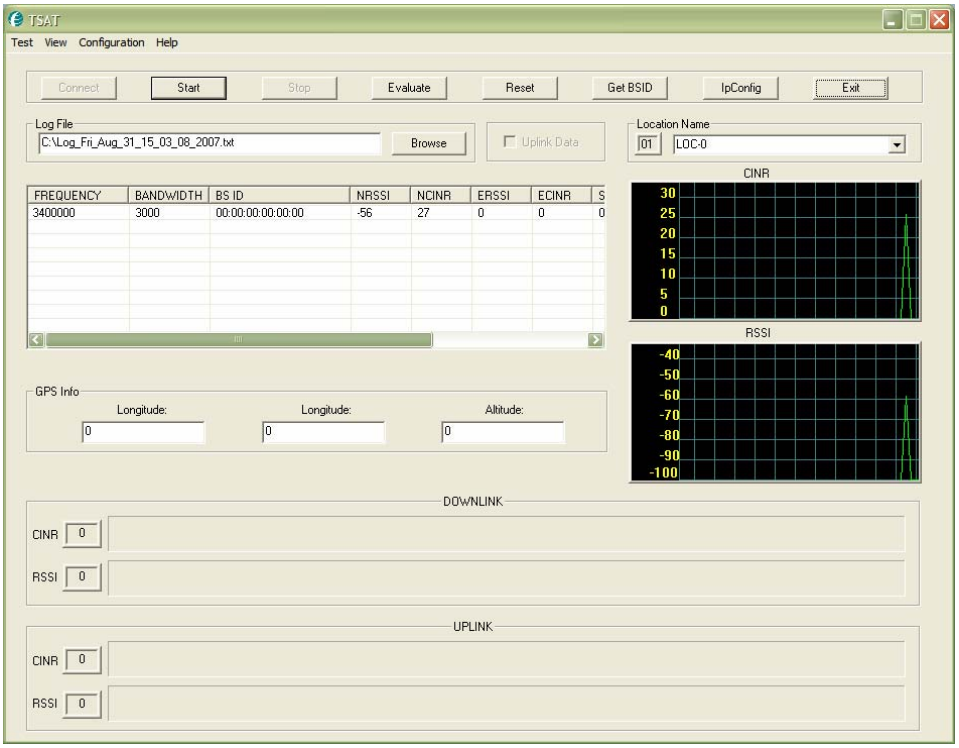

Figure 3 : Scanning the signal/frequency strength in the Best Location Mode

8. Press the **Evaluate** button in the TSAT interface: in the new window, ranked with rank number 1 is the location with the best signal level. Click **OK** to close the window**. MARK MARK MARK**

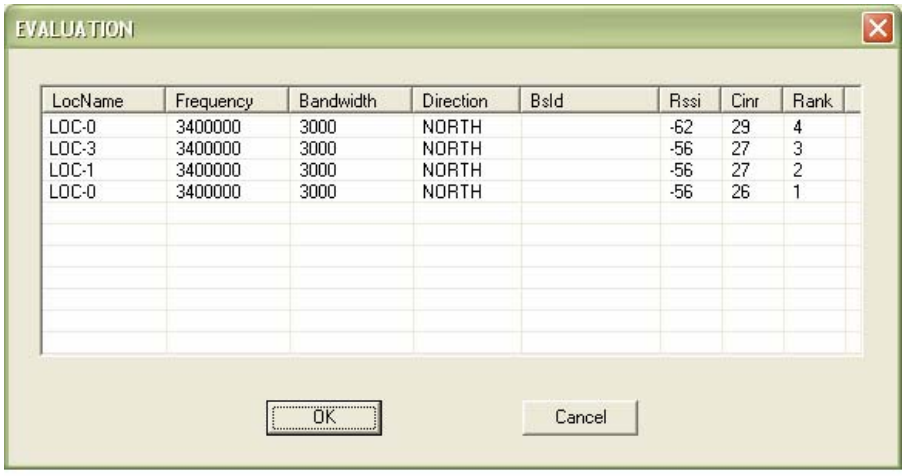
EVALUATION
LocName Frequency Bandwidth Direction Bsld Rssi Cinr Rank
LOC-0 3400000 3000 NORTH -62 29 4
LOC-3 3400000 3000 NORTH -56 27 3
LOC-1 3400000 3000 NORTH -56 27 2
LOC-0 3400000 3000 NORTH -56 26 1
OK
Cancel

Figure 4 : Ranked locations after scanning the signal quality

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- If using a StarMAX(TM) 2130 or 2140 with an indoor omnidirectional antenna, at this point you can place the unit to the location where best RSSI/CINR values were measured.

- If using a StarMAX(TM) 2140 with an external antenna, or a 2150 Subscriber Station, you need to continue to find the best direction for your antenna.

9. Close window (**Exit**).
10. Reboot the SS (Power off, wait a couple of seconds, then power on the station).
11. Configure your PC TCP/IP connection properties to your Wimax operator settings (provided by your service operator).

NOTE: When deciding about the best position, please follow these rules:
- If the CINR value is greater than - 20 then choosing a location with higher RSSI is better.
- If the CINR value is equal or less than -20, then choosing a location with the higher CINR is better.

NOTE: If you think that finding the right direction is more important, you can start the BDF procedure to find the appropriate direction first (as described in chapter 6 of this Manual). Using the Best Location Finder first is not a hard rule, just a suggestion, based on our experience.

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6 Evaluating the direction

If you are using a StarMAX™ Subscriber Station with an outdoor antenna/unit (StarMAX™ 2140 or 2150r1/r2 or 2160), you can find the best antenna direction after finding the best location (according to the procedure in chapter 5 of this manual).

1. Evaluate the location of the antenna as described in chapter 5).
2. Go to **View** and choose **BDF** (best direction finder).
3. In the window check which frequency to use for tuning (the Rank1 frequency from the Evaluate page).

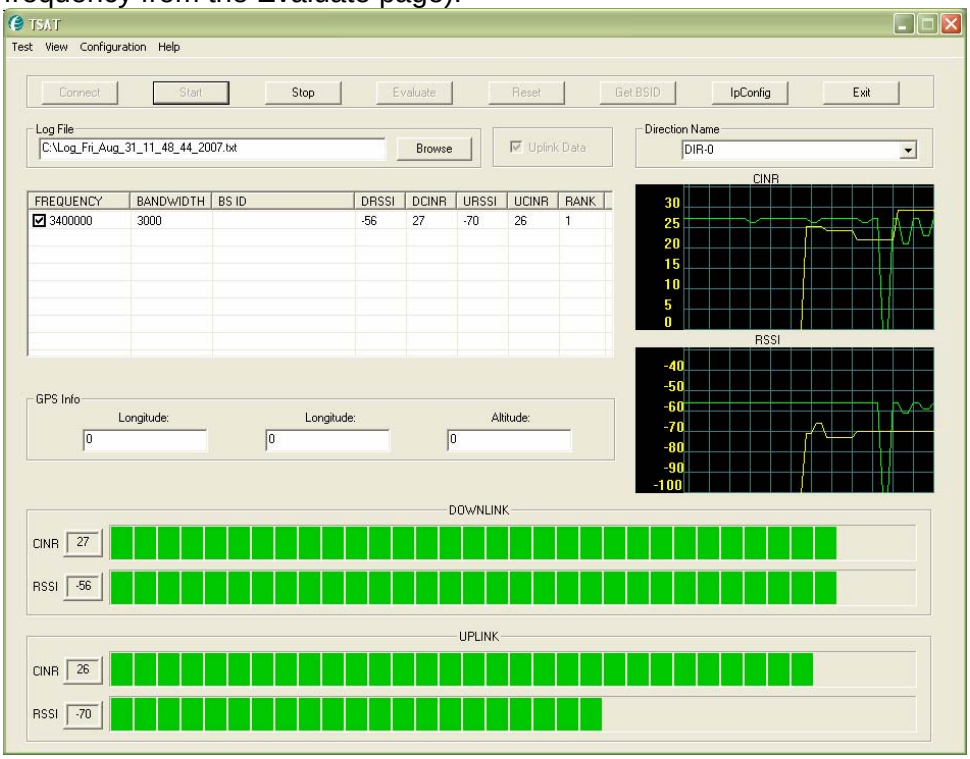

Figure 5 : Checking for best direction

4. Press the **Start** button and align the SS antenna to get the highest CINR value possible.

Note: The StarMAX(TM) 2150 best signal value should have a mucch better RSSI dBi value than the one measured with the 2130/2140 unit according to chapter 5 of this manual. The reason for this is better sensitivity of the outdoor directional antenna, used with the 2150/2160 units.

5. Stop the Best Direction Finder by pressing the **Stop** button.
6. Close window (**Exit**).
7. Reboot the SS (Power off, wait a couple of seconds, then power on the station).
8. Configure your PC TCP/IP connection properties to your Wimax operator settings (provided by your service operator).

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7 Guidelines for optimal positioning of the directed Outdoor Antenna

- Preferably the outdoor unit of the antenna should provide a direct line of sight (LOS) or near line of sight (NrLOS) conditions to the Base Station antenna.
- In the no-line-of-sight (NLOS) conditions direct the antenna towards the Base Station antenna and past the obstructions such as tall buildings, hills, trees etc.
- To achieve a better link quality, place the Subscriber Station antenna as high as possible.
- Preferably the location of the antenna should be easily accessible for a safe installation and testing.
- Install the indoor unit as close as possible to the antenna. Long coaxial cables between the antenna and the Subscriber Station bring additional RF signal attenuation and decrease the link quality.
- When deciding the location of the Subscriber Station, take into account the location of the power outlet and of your data equipment.
- Optimal RSSI and CINR thresholds are specified as:
  RSSI/CINR @ 3MHz: - 84dB/12dB;
  RSSI/CINR @ 6MHz: - 82dB/12dB.
  CINR values lower than 12 dB should not be acceptable.

Note: Higher RSSI & CINR values are better (for example: RSSI value -50 is better than RSSI value -80).

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8 Introducing the Telsima StarMAX™ Subscriber Stations

Telsima's StarMAX™ Alignment Tool is a software program, fully compatible with Microsoft Windows® XP, used to optimally align the StarMAX™ Subscriber Station antenna in the WiMAX wireless access network. The StarMAX™ 2100 Series Subscriber Stations support a wide range of network services.

The StarMAX™ Subscriber Stations are fully compliant and certified with the 802.16-2004 standards and are matched to the frequencies and WiMAX enhanced features supported by the Telsima StarMAX™ Base Station (BS) system. When deployed in networks based on the StarMAX™ BS, they provide optimal performance in line-of-sight (LOS), near line-of-sight (NrLOS) as well as non-line-of-sight (NLOS) applications. The StarMAX™ SS offers market leading performance through the use of intelligent antenna systems and advanced WiMAX features.

The Telsima StarMAX™ system uses OFDM radio technology, which is robust in adverse channel conditions and enables NLOS operation. This helps in easy installation, improves coverage, and maintains a high level of spectral efficiency. Modulation and coding can be adapted per burst, helping to achieve the balance of robustness and efficiency, based on the prevailing link conditions.

The StarMAX™ 2100 Series is currently available with antennas for the 2.6, 3.3 and 3.5 GHz frequency bands, and also of various signal send/receive strengths. The actual operating frequencies used by the system can be configured according to the applicable radio regulations, license conditions and specific deployment.

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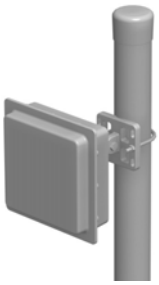
8.1 Brief description of the StarMAX™ 2100 Series Subscriber Stations

The Subscriber Station installed at the customer premises provides data connectivity through the WiMAX wireless network. The Subscriber Station provides the data bridging functionality, traffic shaping and classification through the 10/100BaseT Ethernet port that connects to the computer/data equipment.
The Subscriber Station equipment provides a highly reliable platform for a wide range of wireless/data services. The system also acts as an access device for IP-based communication, providing a throughput of maximum 20 Mbps Half-Duplex operation over a 7 MHz radio frequency channel.
The StarMAX™ 2100 Series includes three types of Subscriber Stations, each one suitable for a different application.

StarMAX™ 2130 Indoor Built-in 4-sector antenna	**StarMAX™ 2140** semi-Outdoor External indoor omni-directional or directional outdoor antenna	**StarMAX™ 2150 r1/r2** Outdoor Built-in directional antenna
		

- The **StarMAX™ 2130 Subscriber Station** is a complete indoor unit with an integrated dynamically switching 4-sector antenna. This type of Subscriber Station is typically used in dense urban/suburban environments where cell sizes are smaller in order to accommodate higher subscriber density. It connects to the data equipment through the Ethernet port.

- The **StarMAX™ 2140 Subscriber Station** consists of an indoor unit with an external antenna connector – it can be used with an indoor stick antenna or an outdoor antenna unit. The antenna is connected to the unit with a coaxial cable. The Indoor unit connects to the data equipment through the Ethernet port.

- The **StarMAX™ 2150 Subscriber Station** is an integrated outdoor Subscriber Station consisting of the modem integrated into the antenna housing. The customer equipment connects to the Subscriber Station directly via an Ethernet cable for data communication. Power is supplied through the same Ethernet cable using Power-over-Ethernet functionality. The StarMAX™ 2150 is available in versions r1 and r2. The main difference is the size/capacity of the antenna and the mounting procedure. The unit connects to the data equipment through the Ethernet.

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9 Required Information

Table 2 lists the parameters required for bringing the Subscriber Station to the minimal operational state.

Item	Parameters	What should be updated
Management Port (mandatory)	IP Address	192.168.1.1
	Subnet Mask	255.255.255.0
RF Interface (mandatory)	Frequency (in kHz)	Sample 3350000, 3360000
	Bandwidth (in kHz)	3500

Table 1: Information needed to get Subscriber Station operational

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10 Configuring Your Computer (MS Windows)

To start aligning your StarMAX™ 2100 Subscriber Station you need to set your PC's IP to the IP address 192.168.1.254 (subnet 255.255.255.0). The IP can be anything in the SS Ethernet IP range (from 192.168.1.2 to 192.168.1.254).

Follow these steps to configure computer for static IP:

1. Click on ***Start*** > ***Settings*** > ***Control Panel***
2. Double click ***Network Connections***
3. Find the LAN connection that is connected to the Subscriber Station, right-click the connection and select ***Properties***.
4. In the ***General*** tab, select ***Internet Protocol*** (TCP/IP) and click ***Properties***.
5. As shown in *Figure 6: Configuration step 1 – IP setting*, select the following options:

a. Use the IP address in the range 192.168.1.2-192.168.1.254 (for example 192.168.1.254)

b. Obtain DNS server address automatically

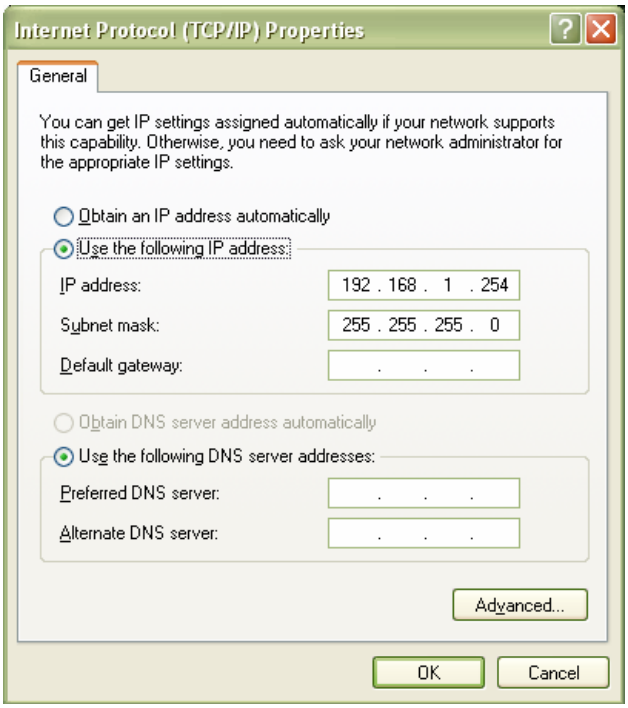
Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 1 . 254
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

Figure 6: Configuration step 1 – IP settings

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11 Antenna radiation pattern

Typical antenna radiation pattern of high gain subscriber station antenna is shown in the below figure. The graph shows that even a small antenna misalignment can cause a significant drop of the RSSI level (10dB points at approximately ±15°).

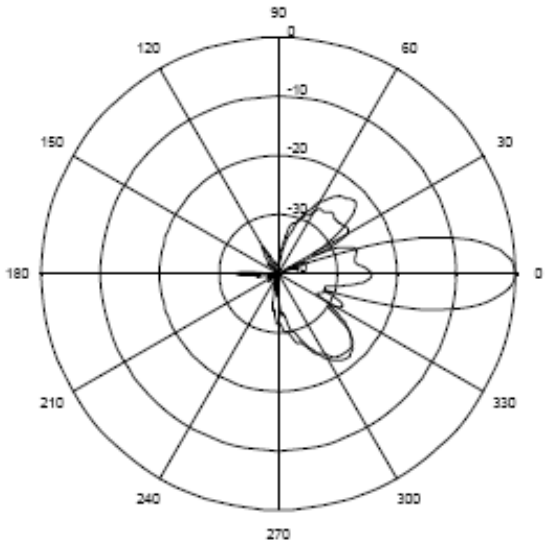

Figure 11: Typical radiation pattern in horizontal and vertical plane of the subscriber station antenna.

11.1 Criteria for antenna alignment

Antennas should be oriented for the highest RSSI level. In the RF environment without interference, the highest RSSI level will match the highest CINR level. In the field installations with many BS sites operating at the same frequency channels, the SS receivers will surely be subjected to a lot of interference during the antenna installation. In that case just the RSSI parameter is not sufficient to select the best BS site/sector – a combination of the RSSI and CINR is needed. For the same reason the testing of the best micro-location with omnidirectional antenna is not recommended.

11.2 Operating channel

In most cases the WiMAX Network Operator operates with only 4 RF channels (entries in the scanner channel list). In urban areas, the installation team or the customer generally can not know which BS site/sector offers the best connectivity. Therefore, in the basic scenario, the antenna alignment procedure has to be repeated at least twice in case of four channels – once for each location (in BLF mode) and at least once to orient the antenna toward the best transmitter one.

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12 Conventions

The following conventions are used in the document to help you to identify special terms.

Convention	Usage	Example
Bold	The following screen elements: Button List Drop-down menu	Click **OK**.

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